

REMARKS

The Office Action mailed August 10, 2007, has been received and reviewed. Claims 1, 3 through 22, 24 through 27, 31 through 40, 42 and 43 are currently pending in the application. Claims 1, 3 through 22, 24 through 27, 31 through 40, 42, and 43 stand rejected.

Claims 1, 7, 14, 18, 24 through 26, 31, 35, 38, and 42 have each been amended to recite "heat treating." Support for these amendments may be found in the as-filed specification at at least page 13, line 25 to page 14, line 3. Claims 1, 7, 14, 18, 24 through 26, 31, and 38 have each been amended to recite "removing portions of the conformal layer ..., the removing consisting essentially of planarizing the conformal layer." Support for these amendments may be found in the as-filed specification at at least page 14, lines 14 through 25 and FIGs. 6A and 7A. Claims 1, 7, 18, 24, 25, and 26 have each been amended to recite "selectively removing the second dielectric layer to form a plurality of spacers at peripheral edges of the plurality of exposed areas of the oxide layer in contact with lateral edges of the first dielectric layer." Claims 14 and 31 have each been amended to recite "selectively removing the first silicon dioxide layer to form a plurality of spacers at the peripheral edges of the plurality of exposed areas of the oxide layer in contact with lateral edges of the silicon nitride layer." Support for these amendments may be found in the as-filed specification at at least FIGs. 6A and 7A. Each of claims 1, 3, 4, 6, 7 through 16, 18, 19, 22, 24 through 26, 31, 35, 38, 42, and 43 has been amended to improve clarity and form.

Applicants have amended claims 1, 3, 4, 6, 7 through 16, 18, 19, 22, 24 through 26, 31, 35, 38, 42, and 43, and respectfully request reconsideration of the application as amended herein.

35 U.S.C. § 112 Claim Rejections

Claims 12 and 13 stand rejected under 35 U.S.C. § 112, first paragraph, as containing subject matter which was allegedly not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventors, at the time the application was filed, had possession of the claimed invention. Applicants respectfully traverse this rejection, as hereinafter set forth.

It is noted that "[t]he claims as filed in the original specification are part of the disclosure and therefore, if an application as originally filed contains a claim disclosing material not

disclosed in the remainder of the specification, the applicant may amend the specification to include the elaimed subject matter." M.P.E.P. §2163.06 (III)

Furthermore, M.P.E.P. §608.01(I) provides:

"[i]n establishing a disclosure, applicant may rely not only on the description and drawing as filed but also on the original claims if their content justifies it. Where subject matter not shown in the drawing or described in the description is claimed in the application as filed, and such original claim itself constitutes a clear disclosure of this subject matter, then the claim should be treated on its merits, and requirement made to amend the drawing and description to show this subject matter. The claim should not be attacked either by objection or rejection because this subject matter is lacking in the drawing and description. It is the drawing and description that are defective, not the claim."

Furthermore, claim of pending claims 12 and 13 recites subject matter that was included in the priority application. Specifically, this application claims priority to, and incorporates by reference, U.S. Patent Application No. 08/823,609, now U.S. Patent 6,097,076. Claims 10 through 12 as-filed specification of U.S. Patent 6,097,076 provide support for present claims 12 and 13. Accordingly, the present specification has been amended to disclose that "etching may be performed using an etch recipe that etches the isolation film 36 and spacer 28 faster than the isolation structure 48 by a ratio in a range of from about 1:1 to about 2:1, more specifically, by a ratio of about 1.3:1 to about 1.7:1."

Claims 12 and 13 have been amended only to correct typographical errors. As such, it is respectfully submitted that claims 12 and 13 meet the written description requirement under 35 U.S.C. § 112 and the rejection should be withdrawn.

35 U.S.C. § 103(a) Obviousness Rejections

Obviousness Rejection Based on U.S. Patent No. 6,097,072 to Omid-Zohoor, in View of U.S. Patent No. 5,387,540 to Poon et al.

Claims 1, 3 through 9, 11, 12, 14 through 22, 24 through 26, 31 through 34, and 38 through 40 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,097,072 to Omid-Zohoor ("Omid-Zohoor") in view of U.S. Patent No. 5,387,540 to Poon et al. ("Poon"). Applicants respectfully traverse this rejection, as hereinafter set forth.

To establish a *prima facie* case of obviousness the prior art reference (or references when combined) must teach or suggest all the claim limitations. *In re Royka*, 490 F.2d 981, 985 (CCPA 1974); *see also* MPEP § 2143.03. Additionally, there must be “a reason that would have prompted a person of ordinary skill in the relevant field to combine the [prior art] elements” in the manner claimed. *KSR Int’l Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1742, 167 L.Ed.2d 705, 75 USLW 4289, 82 U.S.P.Q.2d 1385 (2007). Finally, to establish a *prima facie* case of obviousness there must be a reasonable expectation of success. *In re Merck & Co., Inc.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986). Furthermore, the reason that would have prompted the combination and the reasonable expectation of success must be found in the prior art, common knowledge, or the nature of the problem itself, and not based on the Applicant’s disclosure. *DyStar Textilfarben GmbH & Co. Deutschland KG v. C. H. Patrick Co.*, 464 F.3d 1356, 1367 (Fed. Cir. 2006); MPEP § 2144. Underlying the obvious determination is the fact that statutorily prohibited hindsight cannot be used. *KSR*, 127 S.Ct. at 1742; *DyStar*, 464 F.3d at 1367.

Omid-Zohoor teaches a method of forming trenches with suppressed parasitic edge transistors. Omid-Zohoor at the Abstract. The trenches are formed in a substrate having a pad oxide layer and silicon nitride layer thereon. *Id.* at FIG. 3I. Spacers may flank the trenches. A thick oxide layer is deposited to cover the wafer and fill the trenches. A reverse mask is placed over defined trench regions. The mask is followed by an etch to create oxide ridges. *Id.* at column 4, lines 47-55; FIG. 3L. The upper surface of the oxide layer is polished to expose the silicon nitride layer. *Id.* at FIG. 3M.

Poon teaches forming a trench liner than include silicon dioxide. Poon at column 2, lines 52-59. The trench liner is formed by thermally oxidizing the sidewalls and bottom of the trench. *Id.*

It is respectfully submitted that claims 1, 3 through 9, 11, 12, 14 through 22, 24 through 26, 31 through 34, and 38 through 40 would not have been obvious to a person of ordinary skill in the art at the time the invention was made considering Omid-Zohoor in view of Poon because the combination of Omid-Zohoor and Poon does not teach or suggest all of the claim limitations.

The obviousness rejection is improper because Omid-Zohoor and Poon, alone or in combination, do not teach or suggest all of the limitations of amended independent claim 1. Specifically, the cited references do not teach or suggest the limitation of “heat treating the oxide

layer, liner, spacers, and conformal layer to fuse the oxide layer, liner, spacers and conformal layer,” as recited in amended claim 1. The Examiner asserts that Omid-Zohoor teaches this limitation at FIGs. 3M-N and column 4, line 63 to column 5, line 4. Final Office Action, page 39. The Examiner appears to be relying on the statement in Omid-Zohoor that “while added at distinct times, [the pad oxide and the oxide spacers] are part of the overfilled oxide” in support of this assertion. *Id.* Although Omid-Zohoor teaches that the overfilled oxide includes portions of the oxide spacers and the pad oxide layer, Omid-Zohoor does not teach or suggest fusing such oxide layers by heat treatment. Furthermore, there is nothing in Omid-Zohoor that teaches or suggests that the layers are fused to form a single structure. Poon also does not teach or suggest heat treating oxide layer, liner, spacers and conformal layer to fuse such layers.

It is further submitted that neither Omid-Zohoor nor Poon, alone or in combination, do not teach or suggest the limitation of “removing portions of the conformal layer overlying the remaining portions of the oxide layer, the removing consisting essentially of planarizing the conformal layer at least to the first dielectric layer and each spacer such that an upper surface for each isolation trench is co-planar to the other upper surfaces,” as recited in amended claim 1. Rather, Omid-Zohoor teaches etching an oxide layer to form ridges thereon, followed by planarizing the upper surface of the oxide layer. Because Omid-Zohoor teaches a method that includes removing the oxide layer by etching and planarizing, removing the oxide layer does not consist essentially of planarizing. Poon does not cure this deficiency.

Since the cited references do not teach or suggest all of the claim limitations, it is respectfully submitted that the combination of Omid-Zohoor and Poon does not support a *prima facie* case of obviousness of amended claim 1.

Each of claims 3 through 6 are allowable, *inter alia*, as depending from an allowable base claim.

With respect to independent claim 7, Applicants respectfully submit that Omid-Zohoor and Poon, alone or in combination, do not teach or suggest the limitation of “heat treating the oxide layer, spacers and conformal layer to fuse the oxide layer, spacers and conformal layer,” as recited in amended claim 7. As described above with respect to claim 1, Omid-Zohoor teaches an overfilled oxide layer that includes portions of a pad oxide and oxide spacers, but does not teach heat treating the structure to fuse such layers. Poon does not cure this deficiency.

Moreover, Omid-Zohoor and Poon, alone or in combination, do not teach or suggest the limitation of “removing portions of the conformal layer that overlie the remaining portions of the oxide layer, the removing consisting essentially of planarizing the conformal layer to form an upper surface for each isolation trench that is co-planar to the other upper surfaces,” as recited in amended claim 7. Instead, Omid-Zohoor teaches removing the oxide layer using an etching process followed by planarizing, as described above with respect to claim 1. Thus, removing the oxide layer does not consist essentially of planarizing. Poon does not cure this deficiency.

Since the cited references do not teach or suggest all of the claim limitations, it is respectfully submitted that the combination of Omid-Zohoor and Poon does not support a *prima facie* case of obviousness for claim 7.

Claims 8, 9, 11, and 12 are each allowable, *inter alia*, as depending from an allowable base claim.

Regarding amended independent claim 14, Applicants respectfully submit that Omid-Zohoor and Poon, alone or in combination, do not teach or suggest the limitation of “heat treating the oxide layer, liner, spacers and conformal second silicon dioxide layer to fuse the oxide layer, liner, spacers and conformal second silicon dioxide layer,” for substantially the same reasons as discussed above for claim 1.

It is further submitted that neither Omid-Zohoor nor Poon, alone or in combination, teach or suggest the limitation of “removing portions of the conformal second silicon dioxide layer, the removing consisting essentially of planarizing the conformal second silicon dioxide layer and the spacers to form an upper surface for each isolation trench that is co-planar to the other upper surfaces,” for substantially the same reasons as discussed above for claim 1.

Because the cited references do not teach or suggest all of the limitations of amended independent claim 14, it is respectfully requested that the obviousness rejection be withdrawn.

Claims 15 through 17 are each allowable, *inter alia*, as depending from an allowable base claim.

Regarding amended independent claims 18, 24, 25, and 26, it is respectfully submitted that the cited references, alone or in combination, do not teach or suggest all of the claim limitations because neither Omid-Zohoor nor Poon, alone or in combination, teaches or suggests the limitation of “heat treating the oxide layer, spacers and conformal third layer to fuse the oxide

layer, spacers and conformal third layer,” for substantially the same reasons as discussed above for claim 1.

Moreover, the cited references, alone or in combination, do not teach or suggest all of the limitations of amended claims 18, 24, 25, and 26 because neither Omid-Zohoor nor Poon teaches or suggests the limitation of “removing portions of the conformal third layer, the removing consisting essentially of planarizing the conformal third layer to form an upper surface for each isolation trench that is co-planar to the other upper surfaces,” for substantially the same reasons as discussed above for claim 1.

Since the cited references do not teach or suggest all of the claim limitations, it is respectfully submitted that the combination of Omid-Zohoor and Poon does not support a *prima facie* case of obviousness for any of amended claims 18, 24, 25, and 26.

Each of claims 19 through 22 is allowable, *inter alia*, as depending from an allowable base claim.

Regarding amended independent claim 31, Applicants respectfully submit that Omid-Zohoor and Poon, alone or in combination, do not teach or suggest the limitation of “heat treating the oxide layer, liner, spacers and conformal second layer to fuse the oxide layer, liner, spacers and conformal second layer,” for substantially the same reasons as discussed above for claim 1.

It is further submitted that neither Omid-Zohoor nor Poon, alone or in combination, teach or suggest the limitation of “removing a portion of the conformal second layer, the removing consisting essentially of planarizing the conformal second layer and each of the spacers to form an upper surface for each isolation trench that is co-planar to the other upper surfaces,” as recited in amended claim 31, for substantially the same reasons as discussed above for claim 1.

Because the cited references do not teach or suggest all of the limitations of amended independent claim 31, it is respectfully requested that the obviousness rejection be withdrawn.

Claims 33 through 34 are each allowable, *inter alia*, as depending from an allowable base claim.

Regarding amended independent claim 38, it is respectfully submitted that the cited references, alone or in combination, do not teach or suggest all of the claim limitations because neither Omid-Zohoor nor Poon teaches or suggests the limitation of “heat treating the oxide

layer, electrically insulative material, spacer and second layer to fuse the oxide layer, electrically insulative material, spacer and second layer,” for substantially the same reasons as discussed above for claim 1.

Moreover, the cited references, alone or in combination, do not teach or suggest all of the limitations of amended claim 38 because neither Omid-Zohoor nor Poon teaches or suggests the limitation of “having a planar upper surface formed from the second layer and the spacer and being situated above the oxide layer, wherein the planar upper surface is formed by removing portions of the second layer, the removing consisting essentially of planarizing the entire upper surface contour of the second layer,” for substantially the same reasons as discussed above for claim 1.

Since the cited references do not teach or suggest all of the claim limitations, it is respectfully submitted that the combination of Omid-Zohoor and Poon does not support a *prima facie* case of obviousness for any of amended claim 38.

Each of claims 39 through 40 is allowable, *inter alia*, as depending from an allowable base claim.

Obviousness Rejection Based on U.S. Patent No. 6,097,072 to Omi-Zohoor and U.S. Patent No. 5,387,540 to Poon et al., and Further in View of U.S. Patent No. 6,069,083 to Miyashita et al.

Claims 10, 13, and 27 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Omid-Zohoor and Poon, as applied to claims 9, 12, and 26 above, and further in view of U.S. Patent No. 6,069,083 to Miyashita et al. (“Miyashita”). Applicants respectfully traverse this rejection, as hereinafter set forth.

The teachings of Omid-Zohoor and Poon are as summarized above.

Miyashita teaches etching a silicon dioxide film with respect to a silicon nitride film using an etch recipe that removes the silicon oxide material faster than the silicon nitride material with a selection rate of about 2 to 3. Miyashita, column 2, lines 51-54.

The Examiner relies on Miyashita as teaching an etch recipe that removes a conformal layer faster than a dielectric layer by a ratio in a range from about 1.3:1 to about 1:1. Final Office Action of August 10, 2007, p. 29. However, claims 10 and 13 depend on claim 7 and, therefore,

include all of the limitations of claim 7. As such, claims 10 and 13 include the limitations of “heat treating the oxide layer, spacers and conformal layer to fuse the oxide layer, spacers and conformal layer” and “removing portions of the conformal layer that overlie the remaining portions of the oxide layer, the removing consisting essentially of planarizing the conformal layer to form an upper surface for each isolation trench that is co-planar to the other upper surfaces.” Omid-Zohoor and Poon do not teach or suggest this limitation for the reasons previously discussed. Miyashita also fails to teach or suggest this limitation. Therefore, claims 10 and 13 are each allowable at least by virtue of their dependency from claim 7.

Similarly, claim 27 depends from claim 26 and, therefore includes the limitations of “heat treating the oxide layer, spacers and conformal third layer to fuse the oxide layer, spacers and conformal third layer” and “removing material from the plurality of exposed areas of the oxide layer at locations between adjacent portions of the plurality of spacers to form a plurality of isolation trenches extending into and terminating within the semiconductor substrate.” Omid-Zohoor and Poon do not teach or suggest this limitation for the reasons previously discussed. Miyashita also fails to teach or suggest this limitation. Therefore, claim 27 is allowable at least by virtue of its dependency from claim 26.

Obviousness Rejection Based on U.S. Patent No. 6,097,072 to Omid-Zohoor

Claim 35 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Omid-Zohoor. Applicants respectfully traverse this rejection, as hereinafter set forth.

It is respectfully submitted that claim 35 would not have been obvious to a person of ordinary skill in the art at the time the invention was made considering Omid-Zohoor in view of Poon because the combination of Omid-Zohoor and Poon does not teach or suggest all of the claim limitations.

The obviousness rejection is improper because Omid-Zohoor and Poon, alone or in combination, do not teach or suggest all of the limitations of amended independent claim 35. Specifically, the cited references do not teach or suggest the limitation of “heat treating the oxide layer, spacer and second layer to fuse the oxide layer, spacer and second layer,” as recited in amended claim 35. As described above, the Examiner asserts that Omid-Zohoor teaches this limitation at FIGs. 3M-N and column 4, line 63 to column 5, line 4. Final Office Action, page

39. The Examiner appears to be relying on the statement in Omid-Zohoor that “while added at distinct times, [the pad oxide and the oxide spacers] are part of the overfilled oxide.” *Id.* However, Omid-Zohoor teaches that the overfilled oxide includes portions of the oxide spacers and the thick oxide layer, but does not teach or suggest fusing such oxide layers by heat treatment. Applicants note that Omid-Zohoor does not teach or suggest that the layers have been fused to form a single structure. Poon also does not teach or suggest fusing such an the oxide layer, spacer and second layer by heat treatment.

Since the cited references do not teach or suggest all of the claim limitations, it is respectfully submitted that the combination of Omid-Zohoor and Poon does not support a *prima facie* case of obviousness of amended claim 35.

Obviousness Rejection Based on U.S. Patent No. 6,097,072 to Omid-Zohoor, in View of Wolf, Silicon Processing for the VLSI Era, Vol. 2, pp. 54-55

Claims 36 and 37 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Omid-Zohoor, as applied to claim 35 above, and further in view of Wolf, Silicon Processing for VLSI Era, Vol. 2, pp. 54-55 (“Wolf”). Applicants respectfully traverse this rejection, as hereinafter set forth.

Claims 36 and 37 are each allowable, *inter alia*, as depending from an allowable base claim, namely, claim 35.

Obviousness Rejection Based on U.S. Patent No. 6,097,072 to Omid-Zohoor, in View of Wolf, Silicon Processing for the VLSI Era, Vol. 2, pp. 54-55

Claims 42 and 43 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Omid-Zohoor, in view of Wolf. Applicants respectfully traverse this rejection, as hereinafter set forth.

The teachings of Omid-Zohoor and Wolf are summarized above.

Wolf teaches a method of forming a trench isolation structure that includes doping a region of the substrate below the trench isolation structures. Wolf at page 54.

Each of amended independent claims 42 and 43 recite, *inter alia*, “heat treating the oxide layer, first spacer, second spacer and conformal second layer of the first isolation structure to fuse

the oxide layer, first spacer, second spacer and conformal second layer of the first isolation structure and heat treating the oxide layer, first spacer, second spacer and conformal second layer of the second isolation structure to fuse the oxide layer, first spacer, second spacer and conformal second layer of the second isolation structure.”

It is respectfully submitted the applied references do not teach or suggest all of the claim limitations because Omid-Zohoor and Wolf, alone or in combination, do not teach or suggest heat treating to fuse the oxide layer, first spacer, second spacer and conformal second layer of the first isolation structure and to fuse the oxide layer, first spacer, second spacer and conformal second layer of the second isolation structure. While Omid-Zohoor teaches that “added at distinct times, [the pad oxide and the oxide spacers] are part of the overfilled oxide,” Omid-Zohoor does not teach or suggest heat treating the structure to fuse such oxide layers. *Id.* Moreover, Omid-Zohoor does not teach or suggest that the oxide layers have been fused to form a single structure. Wolf does not cure the deficiency of Omid-Zohoor.

Since the applied references do not teach or suggest all of the claim limitations, it is respectfully submitted that the combination of Omid-Zohoor and Wolf does not support a *prima facie* case of obviousness of claims 42 and 43.

ENTRY OF AMENDMENTS

The amendments to claims 1, 3, 4, 6, 7 through 16, 18, 19, 22, 24 through 26, 31, 35, 38, 42, and 43 should be entered by the Examiner because the amendments are supported by the as-filed specification and drawings and do not add new matter to the application.

CONCLUSION

Claims 1, 3 through 22, 24 through 27, 31 through 40, 42 and 43 are believed to be in condition for allowance, and an early notice thereof is respectfully solicited. Should the Examiner determine that additional issues remain which might be resolved by a telephone conference, the Examiner is respectfully invited to contact Applicants' undersigned attorney.

Respectfully submitted,



Tracey Harrach
Registration No. 57,764
Attorney for Applicants
TRASKBRITT, P.C.
P.O. Box 2550
Salt Lake City, Utah 84110-2550
Telephone: 801-532-1922

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